

Lifetimes of High-Angular-Momentum States in $^{104,105}\text{Pd}$

R.G.Ramos¹, R.M.Clark¹, M.P.Carpenter², M.Cromaz¹, M.A.Deleplanque¹, R.M.Diamond¹, P.Fallon¹,
R.V.F.Janssens², G.J.Lane¹, I.Y.Lee¹, A.O.Macchiavelli¹, F.S.Stephens¹, C.E.Svensson¹, K.Vetter¹,
R.Wadsworth³, D.Ward¹

1 Lawrence Berkeley National Laboratory, Berkeley, CA 94720

2 Argonne National Laboratory, Argonne, IL 60439

3 Department of Physics, University of York, Heslington, York, YO1 5DD, U.K.

Several bands at high angular momentum have been identified in $^{102-105}\text{Pd}$. These bands were initially interpreted [1] as highly deformed intruder bands similar to those known in the $A=130$ region. However, in these Pd nuclei with $Z=46$, the valence-space, relative to the ^{100}Sn spherical doubly magic core, is fairly small and limits the angular momentum of each band. Under such conditions, it is possible that the structures evolve towards a non-collective termination at which point all the single-particle angular momenta from the valence particles is fully aligned along the 'rotation' axis. This situation is analogous to that encountered in the Sn-Sb $A=110$ nuclei [2] where bands have been observed up to the fully aligned terminating state.

For the bands in the Pd isotopes many critical experimental properties remain undetermined. For example, nearly all the bands are unlinked to lower-lying states and therefore the angular momenta, parities, and excitation energies of the in-band states are unknown. Moreover, no lifetime measurements have been performed and the quadrupole moments and deformations of these structures are undetermined. With these considerations in mind we have performed an experiment to investigate the high-angular-momentum structures in $^{104,105}\text{Pd}$ and we have made the first Doppler-shift attenuation measurements of transitions from in-band states.

High-angular momentum states in $^{104,105}\text{Pd}$ were populated via the $^{64}\text{Ni}(^{48}\text{Ca}, \alpha n)$ reactions at a beam energy of 207 MeV. Two different targets of ^{64}Ni were used: a thin target comprising two stacked foils of $380\mu\text{g}/\text{cm}^2$, and a $1\text{ mg}/\text{cm}^2$ foil backed by $62\text{mg}/\text{cm}^2$ of Au. Gamma rays were

detected by the Gammasphere array. A total of 2.9×10^8 (2.4×10^8) events with at least 5 (6) Compton suppressed gamma rays were collected using the thin (backed) target. The thin target data was used to considerably extend the known level scheme and to search for new high-angular-momentum structures. A total of four high-angular-momentum bands were found. Two were known from previous work [1] with one being assigned to ^{104}Pd and one to ^{105}Pd . Both the newly discovered bands were assigned to ^{104}Pd .

In order to get a better estimate of the collectivity of these bands, the quadrupole moments were deduced by measuring the Doppler shift of transitions from states that decayed while the recoil nucleus slowed down in the backed target. In the analysis gates were set on the topmost transitions of the bands to eliminate uncertainty from the unknown sidefeeding into states lower in the cascade. Measured fractional Doppler shifts were then compared with values calculated using standard stopping powers and assuming a constant quadrupole moment along the band of interest. The deduced quadrupole moments were all close to $2.8eb$ corresponding to a relatively small quadrupole deformation of $\epsilon_2 \sim 0.21$. The quality of the fits indicated that our assumption of a constant quadrupole moment along the band was reasonable and that the data were insensitive to any shape changes that might indicate that the bands were approaching the fully aligned terminating state.

References

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2. A.V.Afanasjev et al., Phys. Rep. 322 (1999) 1